

October 17, 2006

Mr. Ralph Butler, Director
Research Reactor Center
University of Missouri-Columbia
Research Park
Columbia, MO 65211

SUBJECT: NRC INSPECTION REPORT NO. 50-186/2006-204

Dear Mr. Butler:

This letter refers to the inspection conducted on September 25 - 28, 2006, at the University of Missouri Research Reactor facility. The inspection included a review of activities authorized for your facility. The enclosed report presents the results of this inspection.

Areas examined during the inspection are identified in the report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observation of activities in progress. Based on the results of this inspection, no significant safety concerns or noncompliances of NRC requirements were identified. No response to this letter is required.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at (the Public Electronic Reading Room) <http://www.nrc.gov/reading-rm/adams.html>.

If you have any questions concerning this inspection, please contact Craig Bassett at 404-358-6515.

Sincerely,

/RA/

Johnny H. Eads, Branch Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Docket No. 50-186
License No. R-103

Enclosure: NRC Inspection Report No. 50-186/2006-204
cc w/enclosure: Please see next page

University of Missouri-Columbia

Docket No. 50-186

cc:

University of Missouri
Associate Director
Research Reactor Facility
Columbia, MO 65201

A-95 Coordinator
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Jefferson City, MO 65102

Test, Research, and Training
Reactor Newsletter
University of Florida
202 Nuclear Sciences Center
Gainesville, FL 32611

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

Docket No. 50-186

License No. R-103

Report No. 50-186/2006-204

Licensee: University of Missouri-Columbia

Facility: University of Missouri Research Reactor

Location: Research Park
Columbia, Missouri

Dates: September 25-28, 2006

Inspectors: Craig Bassett, Lead
Marcus Voth, Qualifying
Kamal Talha, Observer

Approved by: Johnny H. Eads, Branch Chief
Research and Test Reactors Branch B
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

EXECUTIVE SUMMARY

University of Missouri - Columbia
University of Missouri Research Reactor
Report No. 50-186/2006-204

The primary focus of this routine, announced inspection was the onsite review of selected aspects of the licensee's 10 Megawatt (MW) Class I research and test reactor (RTR) safety programs including: organizational structure and functions, review and audit and design change functions, operator requalification, reactor operations, maintenance and surveillance, fuel handling, experiments, procedures and emergency preparedness since the last NRC inspection of these areas. The licensee's programs were acceptably directed toward the protection of public health and safety, and in compliance with NRC requirements.

Organizational Structure and Functions

- The organizational structure and staffing were consistent with Technical Specification requirements.

Review and Audit and Design Change Functions

- The Reactor Advisory Committee and associated subcommittees were meeting as required and reviewing the topics outlined in the Technical Specifications.
- The review and evaluation of changes to facilities and procedures satisfied NRC requirements.

Operator Requalification

- Operator requalification was conducted as required by the Requalification Program and the program was being maintained up-to-date.

Reactor Operations

- Operations shift turnovers and operator cognizance of facility conditions were acceptable.

Maintenance and Surveillance

- The Work Control Program was being used to effectively accomplish maintenance activities at the facility.
- The surveillance program satisfied Technical Specification requirements.

Fuel Handling

- Fuel movements were conducted in accordance with Technical Specification and procedural requirements.

Experiments

- The program for reviewing and conducting experiments satisfied Technical Specification and current protocol requirements.

Procedures

- The procedure revision, control, and implementation program satisfied Technical Specifications requirements.

Emergency Preparedness

- The emergency preparedness program was conducted in accordance with the Emergency Plan.
- Emergency response equipment was available and being maintained as required.
- Emergency drills were being conducted annually as required by the Emergency Plan.

REPORT DETAILS

Summary of Plant Status

The licensee continued to operate their 10 MW research and test reactor in support of laboratory experiments, reactor operator training, various types of research, and irradiation of various target materials. During the inspection, the reactor was being operated 24-hours per day (except during the maintenance period from Monday morning to evening) to support laboratory experiments and conduct product irradiation.

1. Organization and Staffing

a. Inspection Scope (Inspection Procedure [IP] 69006)

To verify that the licensee was complying with the requirements specified in Section 6.1 of the University of Missouri Research Reactor (MURR) Technical Specifications (TS), Revision (Rev.) 13, dated January 29, 2004, the inspector reviewed selected aspects of the following:

- Management and staff responsibilities outlined in the TS
- MURR organization and staffing
- MURR Control Room Logbooks for the period from November 2005 through August 2006
- MURR Console Watch Logbooks for the period from November 2005 through August 2006

b. Observations and Findings

The inspector noted that the organizational structure had not changed since the last inspection in the area of reactor operations (refer to NRC Inspection Report No. 50-186/2006-201). During this time, three individuals (one SRO, one RO and one trainee) left the organization and to-date two have been replaced.

Through a review of selected reactor operations logs for the period from November 2005 through August 2006, and through interviews with operations personnel, the inspector determined that the licensee continued to operate with five crews on a four-shift rotation. This allowed the "extra crew" time for additional training and procedure review on a rotating basis. Each operating crew was staffed with four individuals, with at least three qualified Reactor Operators (ROs) and/or Senior Reactor Operators (SROs) per shift. Records verified the content of shift turnover briefings held during each shift change, indicating that shift activities were discussed in detail. Shifts are scheduled for 12 hour intervals. Staffing during reactor operation satisfied the requirements of TS Section 6.1.i.

c. Conclusions

The MURR organizational structure and staffing were consistent with the requirements of TS Section 6.1 and Figure 6.0.

2. Review and Audit and Design Change Functions

a. Inspection Scope (IP 69007)

The inspector reviewed selected aspects of the following to ensure compliance with TS Section 6.1:

- Reactor Advisory Committee Charter, last revised February 3, 2004
- Reactor Advisory Committee meeting minutes from January 2005 through the present
- Charter of the Reactor Safety Subcommittee of the Reactor Advisory Committee last revised December 15, 1995
- Reactor Safety Subcommittee meeting minutes for January 4, 2006
- Charter of the Isotopes Use Subcommittee of the Reactor Advisory Committee last revised December 15, 1995
- Isotope Use Subcommittee meeting minutes for December 7, 2005
- Charter of the Reactor Procedure Review Subcommittee of the Reactor Advisory Committee last revised January 28, 2005
- Reactor Procedure Review Subcommittee meeting minutes for seven meetings from September 8, 2005 through December 8, 2005
- MURR Administrative Procedure AP-RR-003, "10 CFR 50.59 Evaluations," Rev. 4, issued July 6, 2006
- MURR Administrative Procedure AP-RO-115, "Modification Records," Rev. 2, issued October 20, 2005
- Design Change Package 04-3, "Liquid Radioactive Waste Modification"
- Design Change Package 05-5, "Pool Water Movement System"
- Design Change Package 01-4, Addendum 10, "Replace GE Measurement and Control (GE/MAC) Type 560 Alarm Unit EP No. 920C/D with an API Model 1000 G Alarm Module"
- Design Change Package 01-4, Addendum 11, "Replace GE Measurement and Control (GE/MAC) Type 560 Alarm Unit EP No. 953 with an API Model 1000 G Alarm Module"

b. Observations and Findings

(1) Review and Audit Functions

The inspector noted that the Reactor Advisory Committee (RAC) met four times in 2005 and three times so far in 2006. Minutes of the February 3, 2006 RAC meeting were reviewed along with the minutes of the subcommittee meetings that were held since the previous RAC meeting on November 1, 2005. Through records review the inspector determined that meetings were held as required and safety reviews were conducted by the RAC or a designated subcommittee. Topics of these reviews were as required by the TS and were sufficient to provide guidance, direction, and oversight to ensure acceptable use of the reactor.

The inspector attended a meeting of the Reactor Procedure Review Subcommittee on September 28, 2006. Reviews were being conducted in accordance with the subcommittee charter and requirements of the Technical Specifications.

(2) Design Change Functions

The inspector reviewed Administrative Procedure AP-RO-115 which governs the preparation of design change packages and the four specific design change packages noted above. It was observed that the procedure calls for a 10 CFR 50.59 screen or evaluation, specification of safety committee review and special testing requirements and an evaluation of the impact of the change on the hazards summary report, reactor safety, operating procedures, surveillance procedures, preventative maintenance procedures, spare parts requirements, technical manuals and drawing revisions. Once the modification is approved a work request authorization is processed, followed by a work order, which specifies the isolations, lockouts, work actions, testing, etc. required to implement the change. These administrative processes are designed to control work activities to be performed in the proper sequence with all related activities completed in the end. The inspector attended a meeting on September 27, 2006 announced as "Pool and Primary Heat Exchanger Replacement Update" where key planners reviewed and coordinated progress for a major maintenance activity planned for December 2006. Four specific design changes were reviewed in detail. The design change process was observed to be controlling work activities in a systematic and safe manner in accordance with regulatory requirements.

c. Conclusions

The RAC and associated subcommittees were meeting as required and reviewing the topics outlined in the TS. The design change program was comprehensive and satisfied NRC requirements.

3. Operator Requalification

a. Inspection Scope (IP 69003)

The inspector reviewed selected aspects of the following to ensure compliance with the "Operator Requalification Program - University of Missouri Research Reactor (MURR)" dated January 7, 1997:

- "Change Review Sheets" for 2005 and 2006
- Medical examination records for 2005 and 2006
- "Written Examination Forms" for 2005 and 2006
- "Annual Operating Test Records" for 2005 and 2006
- "Crew Review Forms" for 2005 and 2006

b. Observations and Findings

The inspector witnessed the September 25, 2006 startup being used effectively for on-the-job training of one RO and one SRO candidate. Trainees used written procedures

and checklists throughout the startup and were occasionally queried and advised by licensed personnel regarding the actions taken.

A review of the logs and records showed that training was being conducted in accordance with the licensee's requalification and training program. Procedure reviews and examinations had been documented as required. Information regarding facility changes and other relevant information had been routed under the Crew Review process and licensed operators acknowledged the dissemination of this information. Records of quarterly reactor operations, reactivity manipulations, other operations activities, and Reactor Supervisor activities were being maintained. Records indicating the completion of the annual operations tests and supervisory observations were also maintained. Biennial written examinations were being completed by the operators as required. The inspector also noted that all operators were receiving biennial medical examinations as required by the program.

The inspector reviewed closely the requalification examination administered in November of 2005, finding it to be of a similar level of difficulty as NRC-administered examinations. The inspector verified that an individual who failed one part of the examination was promptly removed from licensed duties until completing remedial training and passing that section of a makeup examination.

c. Conclusions

Operator requalification was being effectively implemented in accordance with the Requalification Program requirements.

4. Reactor Operations

a. Inspection Scope (IP 69006)

To verify that the licensee was operating the reactor and conducting operations in accordance with TS Section 3 and procedural requirements, the inspector reviewed selected portions of the following:

- Operations Shift Turnover sheets for September 2006
- MURR Control Room Logbooks for the period from November 2005 through August 2006
- MURR Console Watch Logbooks for the period from November 2005 through August 2006
- Observation of reactor pre-start checks and startup on September 25, 2006
- Attendance at plan-of-the-day meetings of September 25 and 26, 2006

b. Observations and Findings

The inspector witnessed control room activities during September 25, 2006 pre-startup system checks, reactor safety interlock checks, the approach to critical and the ascent to full power. Written procedures and checklists were used for each activity. The critical rod positions were well within the acceptance criteria of the estimated

(calculated) critical positions. Reactor operators demonstrated knowledge and professionalism in the conduct of their duties.

The inspector attended the "Plan-of-the-Day" (POD) meeting on Tuesday and Wednesday. The meeting, chaired by the Reactor Manager, was held daily and representatives from all organizations at the facility were in attendance. Safety-significant issues, if any, were discussed and any concerns or schedule conflicts were resolved. The inspector noted that the POD meeting provided everyone with an opportunity to be aware of current facility conditions and scheduled activities.

c. Conclusions

MURR operations, shift turnovers and operator cognizance of facility conditions during startup and routine operation were observed to be acceptable.

5. Maintenance and Surveillance

a. Inspection Scope (IP 69006, 69010)

To verify that the licensee was meeting the requirements of their Preventive Maintenance Program and complying with Technical specifications, the inspector reviewed selected aspects of:

- Various MURR Compliance Procedures
- Various "Preventive Maintenance Requirement Cards"
- Selected Compliance Procedure data sheets and records
- MURR Compliance Procedure CP-17, "Emergency Generator Load Test"
- MURR Compliance Procedure CP-22, "Primary Pressure PS944, PT943"

b. Observations and Findings

(1) Maintenance

The inspector attended the weekly Maintenance Meeting on September 27, 2006 where upcoming maintenance activities are discussed. Only the minimum required maintenance activities were scheduled for the coming week to allow personnel to focus on the NRC-administered reactor operator examinations. Records reviewed indicated that preventative maintenance was being performed in a timely manner. The inspector reviewed the Work Control Program that the licensee had developed to handle maintenance activities in the context of a major facility change being planned. (See the discussion of the pool and primary heat exchanger replacement project in Section 2.b(2) of this report.) The maintenance program appeared to be effective.

(2) Surveillance

The inspector reviewed records and procedures for periodic surveillance verifications and calibration of equipment that is required by the Technical Specifications, including the testing of various reactor systems, instrumentation, auxiliary systems, and security systems and alarms. The licensee used "Compliance Procedures" (CPs) to conduct

these verifications and calibrations. The inspector performed a close review of the two randomly selected CPs listed above and concluded that they meet TS requirements. The data recorded on the CP records indicated that the verifications and calibrations had been completed on schedule and in accordance with licensee procedures. The results reviewed by the inspector were noted to be within the TS and procedurally prescribed parameters.

c. Conclusions

The Work Control Program was being used by the licensee to effectively accomplish maintenance and surveillance activities at the facility. The surveillance program satisfied TS requirements.

6. Fuel Handling

a. Inspection Scope (IP 69009)

To ensure that the licensee was following the requirements of TS Sections 3.8, 4.1 and 4.3, the inspector reviewed selected aspects of the following:

- MURR Spent Fuel Inspection Guidelines
- Fuel Status Board located in the Control Room
- MURR Fuel Status Maps sheets developed by the Assistant Reactor Manager - Physics
- Selected Fuel Movement Sheets
- MURR Procedure RP-RO-100, "Fuel Movement," Rev. 4, issued May 18, 2005

b. Observations and Findings

The inspector reviewed the fuel movement process and verified that fuel was moved according to established procedure and in conjunction with the specific fuel movement sheets developed by the Assistant Reactor Manager-Physics for each core loading. The inspector reviewed in detail fuel movement sheets for the May 8, 2006 and September 25, 2006 refueling. They had been developed and used to enforce procedural requirements to minimize the irradiation of pool liner welds or the influence on reactor power monitors. The inspector noted that requirements were properly implemented. The inspector also compared the location of fuel elements in the reactor core with the information maintained on the Fuel Status Board in the Control Room and on the fuel movement sheet for the latest core, Core Number 06-51. No problems or anomalies were noted.

c. Conclusions

Fuel movements were conducted in accordance with TS and procedural requirements.

7. Experiments

a. Inspection Scope (IP 69005)

The inspector reviewed selected aspects of the following to verify compliance with TS Sections 3.6 and 6.1.f:

- Listing of current experiments
- Experiment data sheets, RP-RO-201 Rev. 0, for 2006
- MURR Reactor Utilization Request 414, "Barium Carbonate (Enriched)," approved December 5, 2005
- MURR Reactor Utilization Request 415, "Neodymium Oxide (Enriched)," approved February 27, 2006

b. Observations and Findings

The experiments conducted at the facility were required to be evaluated and reviewed using the Reactor Utilization Request (RUR) protocol. The protocol required an individual proposing a new experiment to evaluate the irradiation of the target material to determine that, if performed within the limitations stated in the RUR safety analysis, the irradiation experiment would remain within the TS limits for experiments. The safety analysis included a review of: 1) thermal effects, 2) possible sample decomposition, 3) experiment failure, 4) loss of coolant flow, 5) corrosive effects of the sample, and 6) possible explosive potential. The inspector reviewed in detail two recently approved RURs along with a more cursory review of numerous others. In the detailed reviews the inspector found that the safety analysis identified a need to dry the sample material and verified that appropriate steps were included in the sample preparation protocol requiring the drying procedure. The experiments were being evaluated in accordance with TS requirements and data sheets indicated that they were within reactivity limits.

c. Conclusions

The program for reviewing and conducting experiments satisfied TS and protocol requirements.

8. Procedures

a. Inspection Scope (IP 69008)

To verify compliance with TS Sections 6.1.b and 6.1.c, the inspector reviewed selected portions of the following:

- MURR Procedure AP-DC-100, "Controlled Document Revisions," Rev. 6, issued July 13, 2006
- MURR Procedure AP-DC-102, "Document Control," Rev. 4, issued May 3, 2006
- MURR Procedure AP-RO-115, "Modification Records," Rev. 2, issued October 20, 2005
- MURR Procedure OP-RO-460, "Pool Coolant System - Two Pump Operation," Rev. 6, issued May 2, 2006 and Rev. 7, issued August 1, 2006
- MURR Procedure RP-RO-100, "Fuel Movement," Rev. 6, issued September 14, 2006

- MURR Special Maintenance Procedure SM-RO-660, "Replacement of Inner and Outer Pressure Vessels," Rev. 0, issued January 6, 2006

b. Observations and Findings

Technical Specification 6.1.b required that the Reactor Manager annually review and approve the Reactor Operating and Emergency Preparedness Procedures. MURR Procedure AP-DC-102, "Document Control," implements this TS. The inspector verified that the various procedures listed were being reviewed annually as required and revised as needed. The above procedures included some that were reviewed without change, some with changes not requiring 50.59 reviews, and others that did require 50.59 reviews. The inspector found that procedure changes were being evaluated as required.

Technical Specification 6.1.c required the RAC review procedure changes with safety significance. The Reactor Procedure Review Subcommittee was chartered to fulfill this requirement. The inspector attended a subcommittee meeting on September 28, 2006, and in addition verified from minutes that the subcommittee was meeting as required to review the current procedure revisions and changes.

c. Conclusions

The current procedure review, revision, control, and implementation program satisfied TS requirements.

9. **Emergency Preparedness**

a. Inspection Scope (IP 69011)

The inspector reviewed selected aspects of the following to verify compliance with the Emergency Plan for the University of Missouri Research Reactor Facility, Rev. 14, dated October 31, 2005:

- 2006 emergency drill scenario documentation
- University of Missouri Research Reactor Emergency Preparedness Drill - Calendar Year 2006
- University of Missouri Research Reactor Annual Emergency Preparedness Drill Critique - 2006, July 13, 2006

b. Observations and Findings

The inspector reviewed the Emergency Drill conducted on June 5, 2006. Since the previous annual drill included offsite agencies, the 2006 drill was restricted to the reactor site response. The emergency scenario was that the fission product monitor alarmed as a result of fuel element damage. Drill monitors were assigned to monitor performance, identify deficiencies and recommend improvements. Corrective action was taken in response to identified deficiencies.

On September 28, 2006 the inspector visited the City of Columbia Fire Department, Station No. 7, met with a Fire Lieutenant, a Fire Engineer and a University of Missouri Public Liaison for Hazards and Assistant Fire Marshall. The inspector determined that there were adequate supplies and equipment available at the FD to handle a fire emergency at the facility. Special operations teams with training in rescue and hazards were reported to be readily available. Training of fire fighters was periodically provided by reactor personnel. There appeared to be a good working relationship between the licensee and this support group.

The same day the inspector also visited the University of Missouri Hospital and observed the emergency response facilities that would be available at the hospital in case of an emergency. Since the hospital also serves the emergency needs of the nearby Calloway Nuclear Power Plant, it is well supplied with staff and equipment relative to the needs of MURR. A State Emergency Management Agency exercise had been conducted the previous day. An ambulance draped for the transport of contaminated victims was displayed along with photographs from the exercise. The inspector noted that there were adequate supplies and equipment available to care for an injured, contaminated MURR licensee staff member. There appeared to be a good working relationship between the licensee and this support organization as well.

c. Conclusions

The emergency preparedness program was conducted in accordance with the Emergency Plan. Emergency response equipment was available and being maintained as required. Emergency drills were being conducted annually as required by the Emergency Plan.

10. Follow-up On Previously Identified Items

a. Inspection Scope (IP 92701)

The inspector reviewed actions concerning one Inspector Follow-up Item (IFI) identified during an inspection in September 2004.

b. Observations and Findings

(Review) IFI 50-186/2004-202-01 - Follow-up on the development and implementation of a procedure dealing with Reactor Utilization Requests.

During the inspection in September 2004, the inspector noted that the Reactor Manager was developing a procedure to more fully address what preparations and actions were required to develop and use an RUR.

During this inspection, the inspector reviewed the status of the development of the procedure for RURs. It was noted that, although a procedure had been initiated, it was still in draft form and not yet complete. The licensee was informed that this item will remain open and will be reviewed during a future inspection.

c. Conclusions

One IFI was reviewed but remains open.

11. Exit Interview

The inspection scope and results were summarized on September 28, 2006, with members of licensee management and staff. The inspector described the areas inspected and discussed in detail the inspection findings.

No dissenting comments were received from the licensee. The licensee did not identify any of the material provided to or reviewed by the inspector as proprietary.

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

K. Brooks, Associate Director, Product & Service Operations
R. Butler, Director, MURR
M. Dixon, Assistant Reactor Manager - Operations
R. Dobey, Health Physics Manager
J. Ernst, Associate Director, Regulatory Assurance Group
L. Foyto, Reactor Manager
J. Fruits, Work Control Manager
C. Herbold, Assistant Reactor Manager - Engineering
R. Hudson, Operations Training Coordinator
D. Kutikad, Assistant Reactor Manager - Physics
W. Meyer, Chief Operations Officer
S. Sample, Lead Senior Reactor Operator

Other Personnel

D. Comegys, Fire Lieutenant, City of Columbia Fire Department
S. Frew, Fire Engineer, City of Columbia Fire Department
J. Simons, EMT Manager, University of Missouri Hospital
D. Sorrell, Assistant Fire Marshal (public liaison for hazards), University of Missouri
D. Wood, Safety Coordinator, University of Missouri Hospital

INSPECTION PROCEDURES USED

IP 69003 Class I Research and Test Reactor Operator Licenses, Requalification, and Medical Activities
IP 69005 Class I Research and Test Reactor Experiments
IP 69006 Class I Research and Test Reactor Organization, Operations, and Maintenance Activities
IP 69007 Class I Research and Test Reactor Review and Audit and Design Change Functions
IP 69008 Class I Research and Test Reactor Procedures
IP 69009 Class I Research and Test Reactor Fuel Movement
IP 69010 Class I Research and Test Reactor Surveillance
IP 69011 Class I Research and Test Reactor Emergency Preparedness
IP 92701 Followup

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Closed

None

Reviewed

50-186/2004-202-01 IFI Follow-up on the development and implementation of a procedure dealing with Reactor Utilization Requests.

LIST OF ACRONYMS USED

CFR	Code of Federal Regulations
CP	Compliance Procedure
E-Plan	Emergency Plan
IFI	Inspector Follow-up Item
IP	Inspection Procedure
IR	Inspection Report
MURR	University of Missouri-Columbia Research Reactor
MW	Megawatt
NRC	Nuclear Regulatory Commission
POD	Plan of the Day (meeting)
RAC	Reactor Advisory Committee
Rev.	Revision
RO	Reactor Operator
RTR	Research and Test Reactor
RUR	Reactor Utilization Request
SRO	Senior Reactor Operator
TS	Technical Specification